The Identifiable *Elysia* from Guam (Elysiidae, Sacoglossa, Opisthobranchia)[1]

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Abstract.—*Elysia arena, E. bayeri, E. bennettae, E. gracilis, E. grandifolia, E. halimedae, E. livida, E. marginata, E. mercieri, E. obtusa, E. ratna, E. vatae* and *E. yaeyamana* are reported from Guam.

Introduction

About sixty-six species of sacoglossan opisthobranchs have been collected from the island of Guam between August 1969 and January 1977. Of these, twenty-nine are ascribable to the genus *Elysia*. After a comparison of radulae (where available), external morphology, and color, thirteen of the Guam species are identifiable with previously described species from the Indo-West Pacific.

The sacoglossan opisthobranchs are distinguished by their association with algae and a radular formula of 0.1.0. An ascus contains the used teeth which are retained within the animal rather than being discarded. Some presumably primitive Sacoglossa have an external shell. Shell-less forms may be smooth and limaciform, flattened with parapodial lobes, or have dorsal cerata.

Members of the genus *Elysia* have no shell nor cerata, but have parapodial lobes extending upward from the body. The rhinophores are auriculate. The digestive gland is ramified and the anal opening is anterolateral to the right.

Methods

The descriptions of the Guam *Elysia* are from living specimens except where otherwise stated. Specimens collected were described, photographed and then preserved in 70% alcohol after freezing. Ethylenediamine was generally used to remove tissue from around the radulae when this was needed. The drawings in this article are made from color slides of the living animals and by camera lucida for the radula.

Systematic Account

Elysia arena Carlson and Hoff, 1977

Figs. 1–3

Carlson and Hoff, 1977: 14–16, figs. 1–5.

DESCRIPTION: Animals are very heavy bodied and covered with conical pro-

[1] Contribution No. 113, University of Guam Marine Laboratory.

jections (Fig. 1). Specimens collected vary in size from 5.0 to 32.0 mm in length. Parapodia are high, irregular in height, and undulating on edges. The pericardium is small and extends posteriorly in a long tube with a thinner tube situated on top of the long tube. Numerous veins extend outward terminating in extremely large, heavy parapodial folds (Fig. 2). These folds are the most distinctive aspect of the animal.

COLOR ALIVE: The color is tan with fine brown flecks and white projections. The folds on the innerside of the parapodia are salmon to orangish tan. The foot is yellow-green. The internal dorsal surface is translucent pale green.

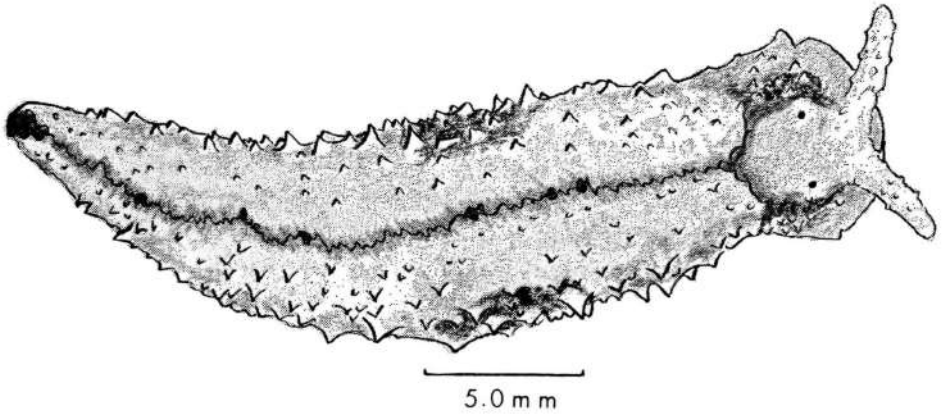

Fig. 1. *Elysia arena*, 27.0 mm.

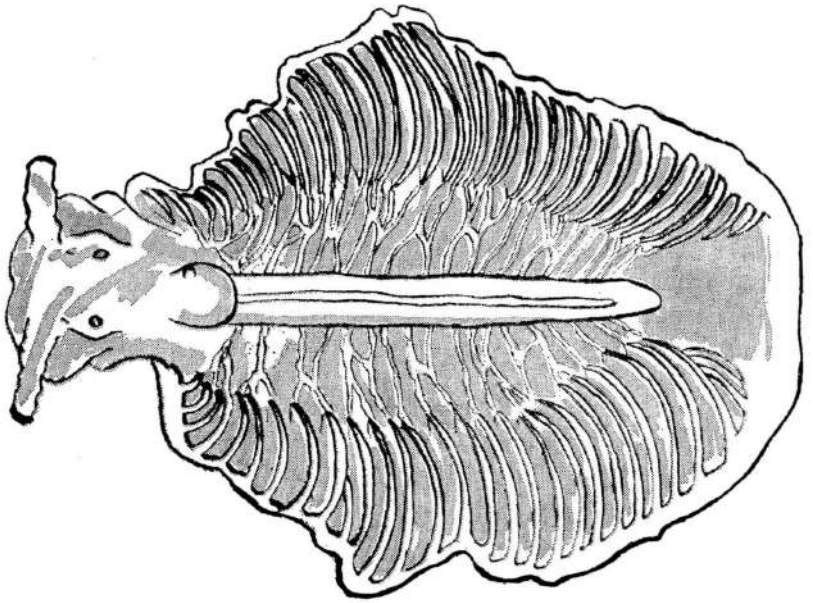

Fig. 2. *Elysia arena* with parapodia opened.

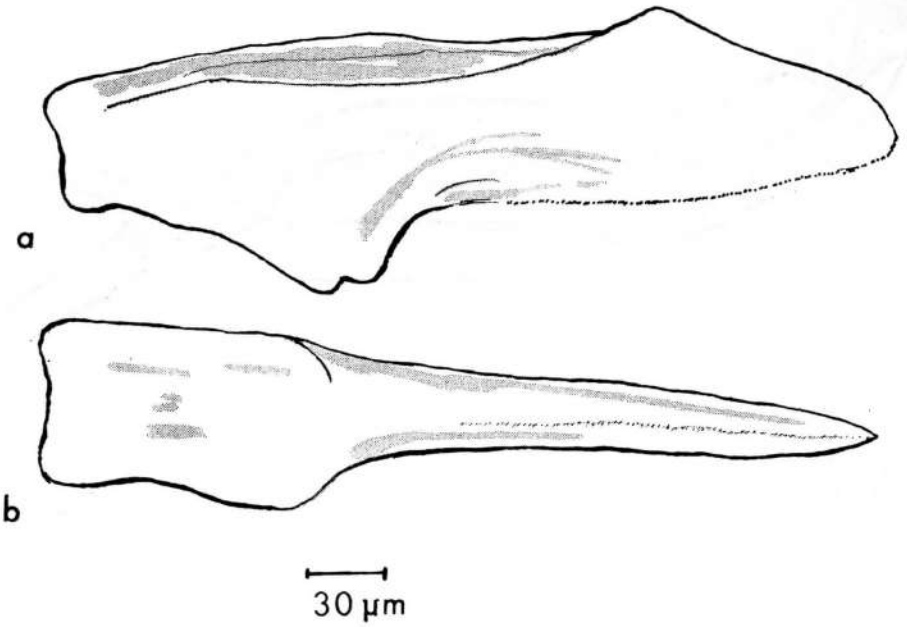

Fig. 3. *Elysia arena*, radula, 14.0 mm preserved specimen: a, lateral view; b, ventral view.

COLOR PRESERVED: The preserved animal is orangish tan.
RADULA: In a 32.8 mm specimen there were twenty-three teeth in the descending series and seven in the ascending with no loose teeth in the ascus. The teeth are very finely serrate on the cutting edge. The tooth in use (Fig. 3) was 310 μm long.
HABITAT: Specimens of *Elysia arena* have been found only in an area with thick sand substrate, at a depth between 0.5 to 1.5 m, in two species of *Caulerpa*; *C. racemosa* (Forskal) J. Ag. and *C. cupressoides* (West) C. Ag. The animals are found just under the surface of the sand around the rhizoids of the algae. Animals have been found in May, June, July, October and November.
SPECIMENS: Twenty-nine specimens have been found on Guam, [type locality] (Carlson and Hoff) all inside Cocos Lagoon in southern Guam, west of a small sand island near Cocos Island.
REMARKS: The animals are very distinctive in having the large parapodial folds and in their habit of living under the sand.

Elysia bayeri Marcus, 1965
Figs. 4, 5b, 6a–b

Marcus, 1965: 270, figs. 5, 6.
DESCRIPTION: The animals (Fig. 4) are long and thin when crawling. Specimens collected vary in size from 12.7 to 16.0 mm in length. Parapodia are held erect with edges normally joined in a fairly smooth to slightly wavy line and extend almost to the end of the rounded tail. The body surface is smooth. The peri-

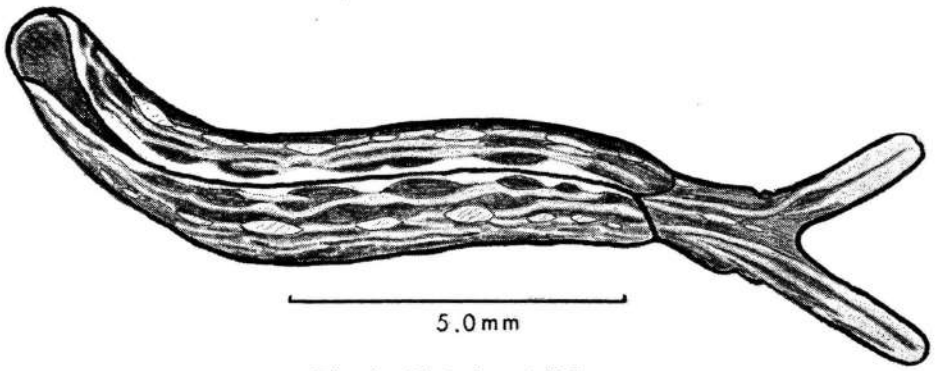

Fig. 4. *Elysia bayeri*, 12.7 mm.

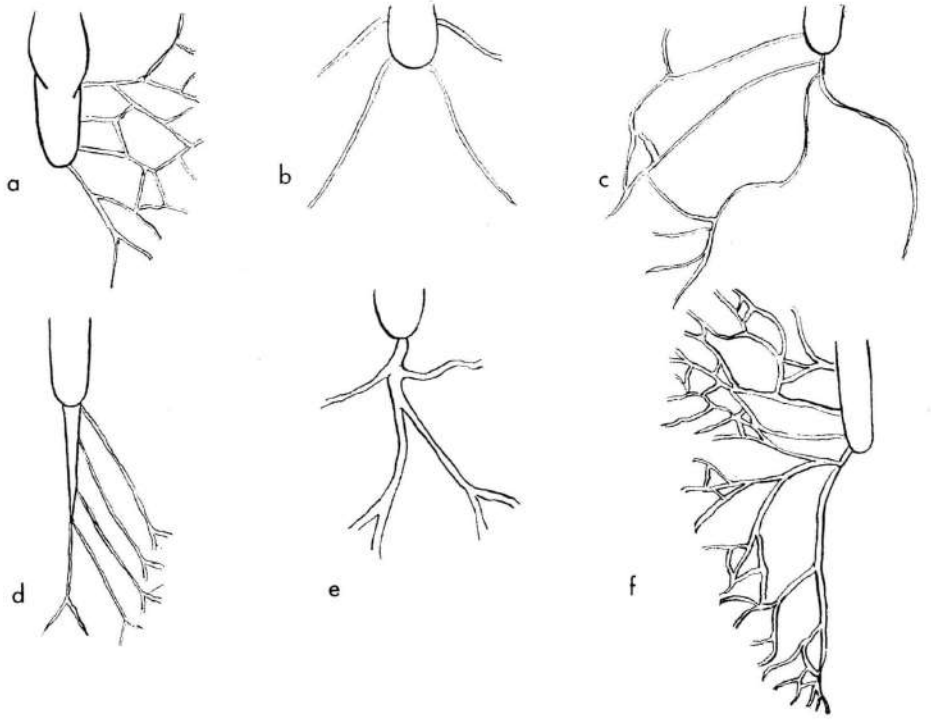

Fig. 5. Pericardium and veining (not to scale): a, *E. marginata*; b, *E. bayeri*; c, *E. vatae*; d, *E. halimedae*; e, *E. ratna*; f, *E. grandifolia*.

cardium (Fig. 5b) is small, rounded, and has only two pair of veins extending into the parapodia, one pair lateral and the other posterolateral.

COLOR ALIVE: The color of the Guam specimens match the description of Marcus (1965), but some variation was noted. Most animals are black with irregular cream and yellow stripes and a longitudinal blue stripe along the side of the foot. About one third of the distance from the margin of the parapodia is a series of elongate blue spots. The inner edge of the parapodia is orange as are the tips

of the rhinophores. The head and lower part of the rhinophores are black and white striped. The head has a few blue spots. A few animals are brown instead of black with a pink parapodial rim and a yellow spot on the head. The blue spots on the outer side of the parapodia appear in all animals.

COLOR PRESERVED: The preserved animal is tan with the stripes and the blue spots in the living animal showing as a lighter tan.

RADULA: In a 15.9 mm specimen there were four teeth in the ascending series, eight in the descending, and numerous loose teeth in the ascus. The teeth are denticulate on both sides with a long, shallow groove on the outer surface. The

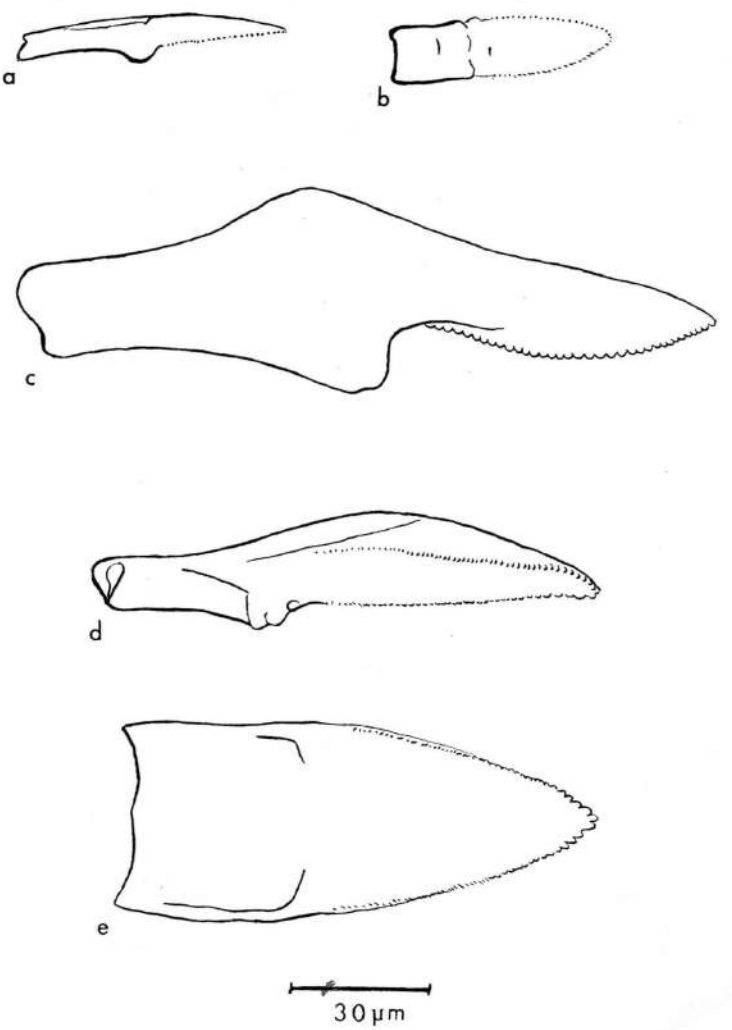

Fig. 6. Radulae (all to same scale): a, *E. bayeri* (15.9 mm) lateral view; b, *E. bayeri* (15.9 mm) ventral view; c, *E. bennettae* (22.2 mm) lateral view; d, *E. gracilis* (25.4 mm) lateral view; e, *E. gracilis* (25.4 mm) ventral view.

tooth in use (Figs. 6a, 6b) was 59 μm long with base and cusp about equal in length.
HABITAT: Specimens of *Elysia bayeri* have been found on Guam from the reef flat to a depth of 6 m but are most commonly found between 1.5 and 2.0 m. They have been found throughout the year but are most frequent during August, September, and October. No definitive algal relationship has been established for *E. bayeri.*
SPECIMENS: Sixty-seven specimens have been found on Guam at Bile Bay, Cetti Bay, Cocos reef, Double Reef, Gun Beach, and Tanguisson, all on the leeward side of the island.

Elysia bayeri was described from the Marshall Islands (Marcus, 1965) and has also been observed by the authors at Sarigan and Maug in the Mariana Islands and in Palau.
REMARKS: Although Marcus (1965) does not describe the teeth as being denticulate on both sides, there is little question that the Guam specimens and that described by Marcus are the same. It would be most unusual to have the same elaborate color patterning in two different species. The drawing of the radula given by Marcus (1965) is identical to that made of the Guam animal if viewed from the side. Marcus mentions that the tip of the cusp has a curved point. The denticles on the tip give that impression from a side view. When the tooth is viewed dorsally or ventrally, it is obviously denticulate on both edges.

Elysia bennettae Thompson, 1973
Figs. 6c, 7

Thompson, 1973: 248, figs. 2a, 3f; Thompson and Bebbington, 1973: 159, Pl. 8a.
DESCRIPTION: The animals (Fig. 7) are very elongate with high, fluted parapodia frequently opened irregularly and with a shield-like prominence on the head. Specimens collected vary in size from 22.2 to 30.8 mm in length. The body surface is smooth. The pericardium is moderately long, constricted in the middle. The veining is complex with many branches but is transparent and very difficult to see

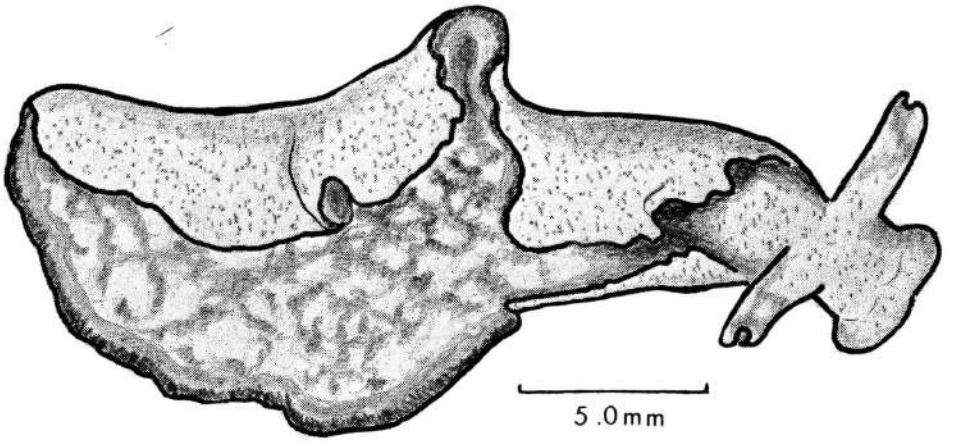

Fig. 7. *Elysia bennettae,* 25.0 mm.

because of the color patterns inside the parapodia. The veining extends almost to the edge of the parapodia.

COLOR ALIVE: The color of the Guam specimens is as described by Thompson (1973) with a pale green body thickly mottled with red specks. The outer edge of the parapodia is bright redpurple. The internal dorsal surface and inner surface of the parapodia are chartreuse mottled with whitish green blotches. The inner parapodial edge is a vivid orange. The pericardium is covered with red dots.

COLOR PRESERVED: The preserved animal is a uniform light tan. The constriction of the pericardium is obvious but on some preserved animals the veining cannot be seen. On one preserved specimen the posterior pair of veins and some irregular veining on the parapodia were visible.

RADULA: In a 22.2 mm specimen there were four teeth in the ascending and six in the descending series. We did not get a good description of the ascus. The teeth are as described by Thompson, heavily serrate with about 40 serrations on the cutting edge of the tooth. The tooth in use (Fig. 6c) was 150 μm long.

HABITAT: Guam specimens of *Elysia bennettae* have only been found on the reef flat in June, September, October, and November. Three of the specimens were on the green alga *Chlorodesmis fastigiata* (C. Ag.) Ducker.

SPECIMENS: Six specimens have been found on Guam at Bile Bay, Sella Bay and Toguon Bay on the leeward side of the island.

Elysia bennettae was described from Australia (Thompson, 1973).

REMARKS: The Guam specimens have been identified as *Elysia bennettae* because their external morphology, color and radula match *E. bennettae* as described by Thompson. The only difference is that the inner parapodial edge on the Guam animals is not pale as in the original description but is a vivid orange.

Elysia gracilis Risbec, 1928

Figs. 6 d–e, 8

Risbec, 1928: 278, fig. 93, Pl. X, fig. 5; 1930: 296, fig. 68; 1953: 167, figs. 119a, 120.

DESCRIPTION: The animals (Fig. 8) are long and thin when crawling. Specimens collected vary from 6.0 to 25.4 mm in length. The parapodia are held erect and normally join in a fairly smooth line and extend to the end of the tail. The body surface is smooth. Rhinophores are thicker toward the tip than they are at the base. The pericardium is very small and rounded.

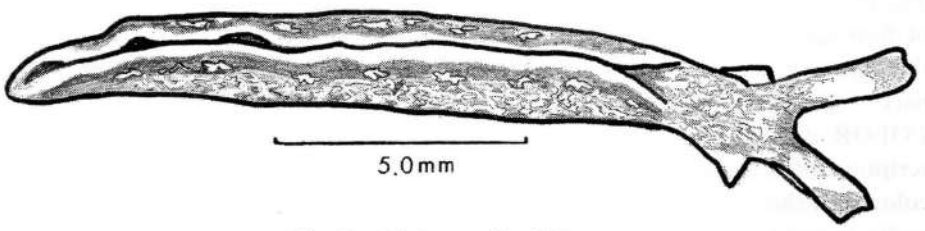

Fig. 8. *Elysia gracilis*, 15.9 mm.

COLOR ALIVE: The Guam animals are like those described by Risbec (1928) in having orange on the border of the parapodia, tips of rhinophores, and anterior of foot. They are also very dark green with pale green or yellowish clear areas. The Guam specimens are distinguished by a single row of eight whitish spots along the side of the parapodia.
COLOR PRESERVED: The preserved animals are light tan with a broad irregular, dark submarginal border on the inner edge of the parapodia and dark on the tips of the rhinophores and on the head.
RADULA: In a 25.4 mm animal there were ten teeth in the ascending series, eleven in the descending, and a pile of loose teeth in the ascus. The teeth are as described by Risbec (1928, 1953) with fine lateral denticulations. The tooth in use (Fig. 6d, 6e) was 110 μm long and 42 μm wide at the widest point.
HABITAT: Guam specimens of *Elysia gracilis* have been found from the reef flat to 2.4 m. One specimen was found in May, two in June, one in October and two in November. No definitive algal relationship has been established.
SPECIMENS: All six specimens have been found at Bile and Agat Bays on the leeward side of Guam.

Elysia gracilis was described from New Caledonia (Risbec, 1928) and has also been observed by the authors at Pagan and Maug in the Mariana Islands.
REMARKS: The Guam specimens differ from Risbec's description in having a single row of eight whitish spots rather than eight rows of whitish spots and they also do not have the white "T" on the head. Other than that, the description, color and radula match that given by Risbec.

Elysia grandifolia Kelaart, 1858
Figs. 5f, 9, 10a, 11

Kelaart, 1858: 119; 1859: 493; Eliot, 1906: 689, Pl. XLVI, fig. 4; 1908: 96–97; O'Donoghue, 1932: 141–142, fig. 1; Abe, 1964: 34, 83: Pl. XI, fig. 40; Narayanan, 1968: 191, figs. 2a, 2b; var. *orientalis* Baba, 1957: 72.
DESCRIPTION: The animals (Fig. 9) are long and thin with extremely large parapodia generally held close but not necessarily together when the animal is crawling. Specimens collected vary from 28.6 to 50 mm in length with a 46.0 mm specimen being 24.0 mm wide with parapodia flattened. When on the host algae the parapodia are quite often opened. The parapodia rise abruptly anteriorly and remain high for about two thirds of the body length then slope toward the tail. The pericardium (Fig. 5f) is elongate with a very obvious venous network composed of four major veins with numerous branches which are anastomose extending to the edge of the parapodia. The anus opens laterally on the right side in the upper part of the transverse furrow separating the head from the rest of the body.
COLOR ALIVE: The color of the Guam specimens basically matches the description of Kelaart (1859). The living animal appears somewhat olive drab in color with the green being caused by internal pigmentation. The edge of the parapodia is lined in opaque black with a submarginal band of rust. The lower two-

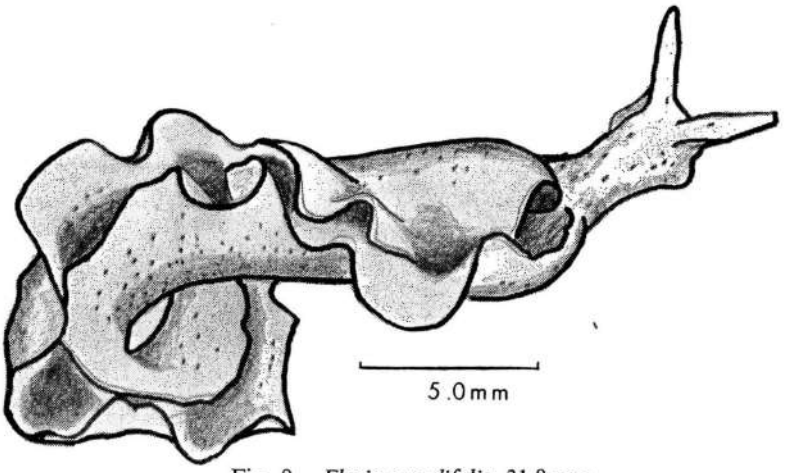

Fig. 9. *Elysia grandifolia*, 31.8 mm.

thirds of the parapodia is covered with scattered black spots. These spots become elongate inside the lower parapodia and on the head. There are also some sparce white spots over the head and parapodia and a few orange spots inside the parapodia. The entire rim of the rhinophores is black with some submarginal faint orange toward the tip and dorsal edge. The foot is white to greenish white with some scattered black spots.

COLOR PRESERVED: Animals preserved by the authors in 1971 are a uniform tan with a slight darkening on the edges of the rhinophores. None of the black spotting has been retained. A single specimen that has been in preservative for only three months has retained all of the black pigmentation as in the living animals. Both Eliot (1908) and O'Donoghue (1932) mention retention of the spots in preserved specimens.

RADULA: In a 28.5 mm specimen, there were seven teeth in the ascending series, seven in the descending, and many loose teeth in the ascus. The tooth in use (Fig. 10a) was 199 μm in length. The narrow teeth have a short base and long blade and are minutely serrate along the cutting edge of the tooth, a characteristic also mentioned by Eliot (1906, 1908) and O'Donoghue (1932).

HABITAT: Guam specimens of *Elysia grandifolia* have been found only on the reef flat on the green alga *Bryopsis pennata* Lamx.

SPECIMENS: Forty-four specimens have been found on Guam, all at Pago Bay on the windward side of the island.

Elysia grandifolia was described from Ceylon (Kelaart, 1858, 1859) and reported from the Red Sea (Eliot, 1908), India (Eliot, 1909; O'Donoghue, 1932; Narayanan, 1968) and Japan (Baba, 1957; Abe, 1964).

REMARKS: The Guam specimens are identified as Kelaart's *E. grandifolia* on the basis of the extremely broad leaflike parapodia and the very distinct veining (Fig. 11) inside the parapodia and the additional color and radular descriptions by Eliot (1906, 1908) and O'Donoghue (1932).

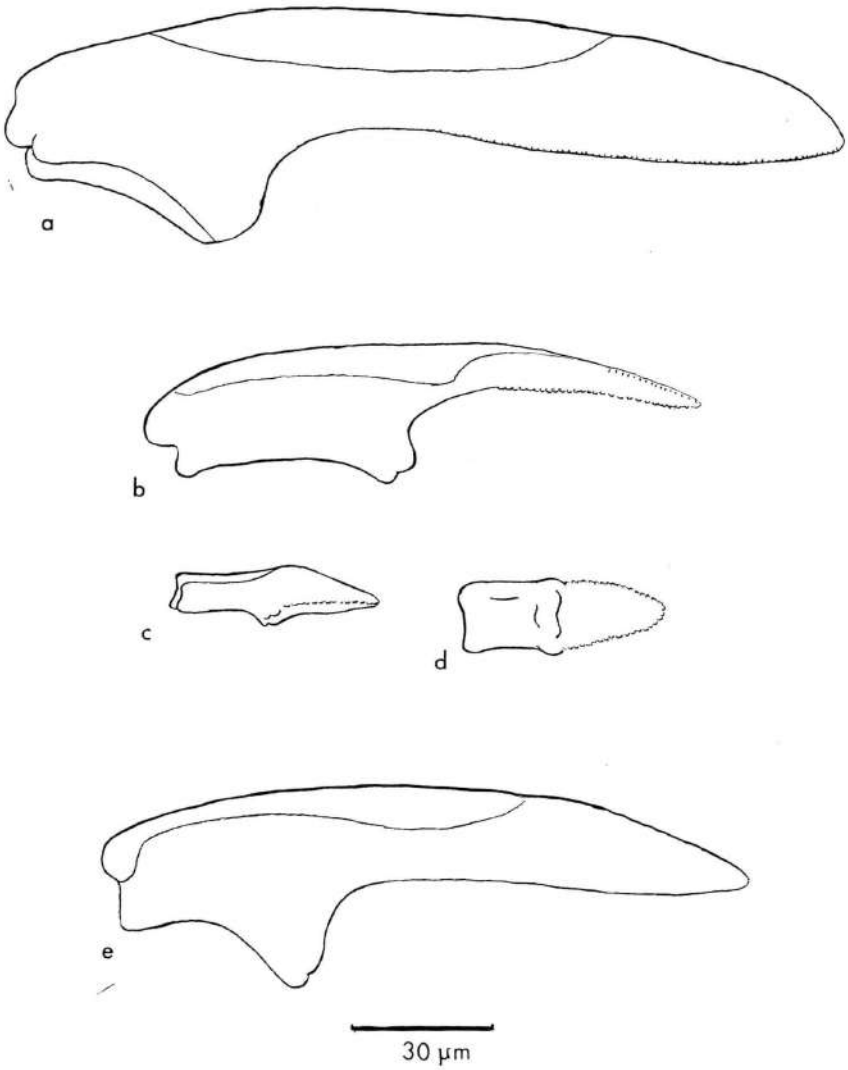

Fig. 10. Radulae (all to same scale): a, *E. grandifolia* (31.6 mm) lateral view; b, *E. halimedae* (8.5 mm) lateral view; c, *E. livida* (8.0 mm) lateral view; d, *E. livida* (8.0 mm) ventral view; e, *E. marginata* (28.6 mm) lateral view.

There seems to be some question as to the date to be used for *E. grandifolia*. Macnae (1954) uses 1857 for *E. punctata* which was published with *E. grandifolia*; Eliot (1906) discusses Kelaart's papers and uses the 1859 date of the Annals and Magazine of Natural History "as being more accessible than the other publications." O'Donoghue (1933) also discusses Kelaart's papers and establishes a date of 1858, the same as later used by Narayanan (1968). In this paper we are following O'Donoghue.

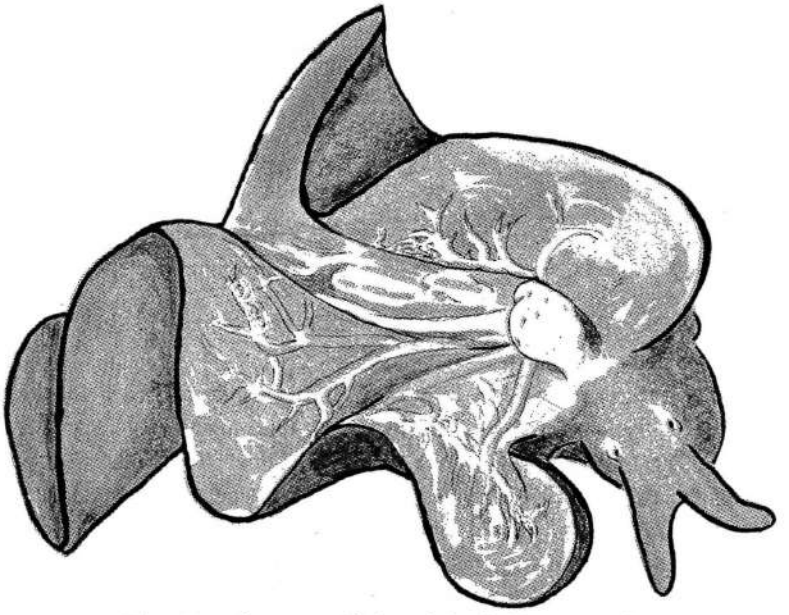

Fig. 11. *Elysia grandifolia*, veining inside parapodia.

Occasions where *E. grandifolia* has been synonomized with other species are discussed in the remarks section of *E. marginata* in this paper.

Elysia halimedae Macnae, 1954
Figs. 5d, 10b, 12

Macnae, 1954: 57–59, fig. 2; Pl. III, fig. 2; Baba et al., 1956: 218, Pl. XXIV, fig. 6; 1957: 70, Pl. III, fig. 1; Pl. IV, figs. 1a, 1b; Burn, 1972: 177, fig. 10.

DESCRIPTION: The animals (Fig. 12) are very long and thin when crawling but when at rest are very broad. Specimens examined vary from 2.0 to 11.0 mm in length. The parapodia are very high, join in a smooth line and terminate about two-thirds of the way back on the animal. The tail is very long, broad and rounded. The pericardium (Fig. 5d) is long and terminates in a long tube which becomes thinner posteriorly and terminates in a point. From the tube four pairs of veins extend lateroposteriorly and one vein extends posteriorly. The veins divide near the edge of the parapodia with very short branches.

COLOR ALIVE: The color of the Guam specimens is as described by Macnae (1954); dark green with white spots and with rhinophores brownish. The animals are quite variable in the green coloring, sometimes being almost white, but most frequently are dark green.

COLOR PRESERVED: The preserved animals are tan with some flecks of brown on the tips of the rhinophores. The elongate pericardium and long tube are distinct but the veining is often hard to see on the preserved animals.

RADULA: The radula is as described by Macnae (1954) and is very distinctive

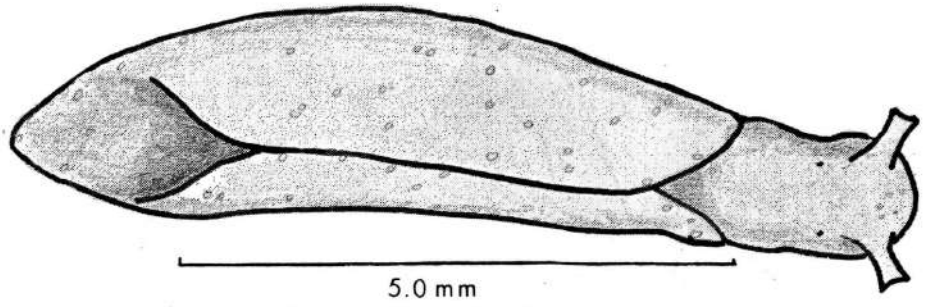

Fig. 12. *Elysia halimedae*, 8.5 mm.

in having denticulations along the blade and along the sides from the level of the distal end of the furrow almost to the tip. The Guam animals vary somewhat in whether or not the lateral denticles are clearly visible. On an 8.5 mm animal the denticulations on the cutting edge and on the lateral edges were clearly visible at 400 power. On a 7.9 mm animal no lateral denticulations were visible at 1000 power but those on the cutting edge were, but not at 400. On a 6.4 mm animal both cutting edge and lateral denticulations were visible at 1000 power but lateral denticulations could only be seen on the newest teeth. On a 7.9 mm animal the tooth in use (Fig. 10b) was 100 μm. There were five ascending, twelve descending, and numerous teeth in the ascus. The descending row and ascus is extremely long, longer than the pharynx itself and curves back at the tip.

HABITAT: Most of the animals found on Guam have been on the green algae *Halimeda macroloba* Decaisne. They are normally found on the reef flat although some have been observed down to 2.4 m.

SPECIMENS: Thirty-nine specimens have been found on Guam at Agat Bay, Apra Harbor, Bile Bay, Cetti Bay, Cocos reef, Cocos Lagoon and San Nicolas Beach —all on the leeward side of the island.

Elysia halimedae was described from South Africa (Macnae, 1954) and reported from Japan (Baba, 1956; Baba et al., 1957) and Australia (Burn, 1972), and has been observed by the authors at Maug in the Mariana Islands and Ponape in the Eastern Caroline Islands.

REMARKS: The description, color and radula match that given by Macnae (1954) except the Guam animals do not have any blue spots. The blue spots are also not mentioned for the specimens noted in Japan.

Elysia livida Baba, 1955

Figs. 10c–d, 13

Baba, 1955: 12, 43, fig. 13, Pl. IV, fig. 10; Abe, 1964: 34, 83, Pl. XI, fig. 39.

DESCRIPTION: The animals (Fig. 13) are long, narrow and smooth bodied with high parapodia sloping to a pointed tail. The parapodia normally join evenly. The pericardium is small, elongate and has two long veins extending posteriorly along the lower internal part of the parapodia. The veins branch regularly, with

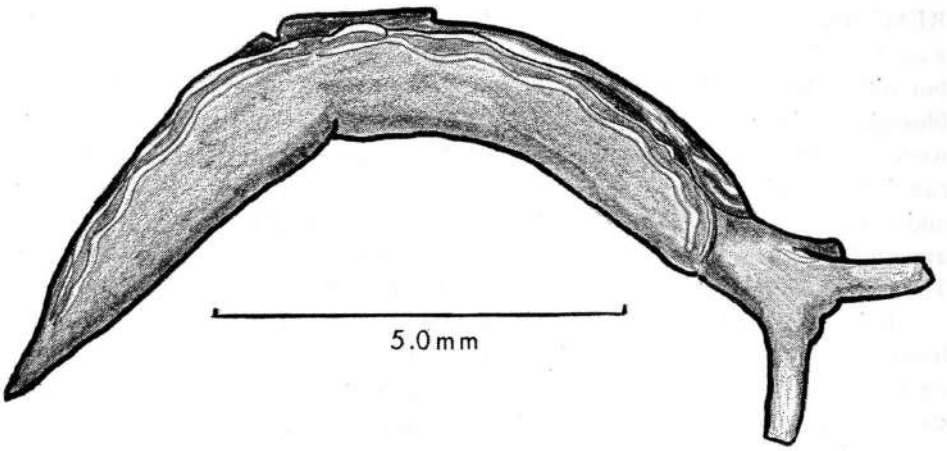

Fig. 13. *Elysia livida*, 12.7 mm.

around seven branches extending up into the parapodia and divide again near the edge of the parapodia. The anus is anterolateral.

COLOR ALIVE: The Guam specimens appear basically black to the naked eye with an orange and blue stripe parallel to the edge of the parapodia. Through the microscope the specimens are brownish purple with distinct lines along the outer edge of the parapodia. At the edge is a narrow black line, a submarginal narrow orange line, a wide black line, and a narrow turquoise blue line. The rhinophores are tinged with orange toward the tip. There are also orange and blue stripes on each side of the head. The coloring of the Guam animals is basically the same as that described by Baba (1955).

COLOR PRESERVED: The preserved animals are tan with the black lines on the parapodia and head still visible. The area which is orange on the living animal is clear.

RADULA: In an 8.0 mm specimen there were nine teeth in the ascending, and twenty in the descending series, including three juvenile teeth curled in the row at the end of the radular ribbon. The teeth are finely denticulate on both sides. The tooth in use (Fig. 10c, 10d) was 46 μm in length.

HABITAT: Specimens of *Elysia livida* have been found throughout the year on Guam but most frequently in June, July, and August. No algal association has been established for this species. One egg mass produced in a plastic cup in the laboratory was a bright orange in color and contained three rings totaling 5.0 mm in diameter. Each strand was 0.5 mm wide, the capsules 110 μm wide with the egg approximately 60 μm in diameter inside the capsule.

SPECIMENS: Since we were previously unaware that we had combined two species as one, our total count for *Elysia livida* is invalid. Specimens have been collected at Bile Bay on the lee side of the island.

Elysia livida was described from Japan (Baba, 1955) and reported from Japan (Abe, 1964).

REMARKS: During the work on this article the authors discovered that there were two different species from Guam that are very close in external appearance but differ significantly in the shape of the teeth. The other species is black or blue-black with a narrow black line on the edge of the parapodia, a submarginal narrow orange line, a wide black line and then a broad irregular area of blue-black running parallel to the edge of the parapodia. The tips of the rhinophores are blue and there are no lines along the side of the head as found in *E. livida*. The teeth are much narrower than those of *E. livida* and are coarsely denticulate on both sides. The preserved animals are grey with a white and black band on the parapodia.

Baba's (1955) drawing of the teeth of *E. livida* is identical to a side view of those from Guam. Although in the original description the teeth are given as denticulate on the ventral edge, recent correspondence with Baba and the authors' findings show that the teeth are finely denticulate on both sides.

The identification of the Guam specimens as *E. livida* is based on the description, color and radula as originally given by Baba and the clarification of color and radula in the correspondence with Baba.

Elysia marginata (Pease, 1871)
Figs. 5a, 10e, 14

Pterogasteron ornatum Pease, 1860: 36.
Pterogasteron marginatus Pease, 1871: 304, Pl. 21, fig. 3.
Pterogasteron nigropunctatus Pease, 1871: 304–305, Pl. 22, figs. 2a, 2b, 2c, 2d.
Elysia ornata Bergh, 1905: 84–85, Pl. II, fig. 20. Pl. XIII, figs. 22, 23; Risbec, 1928: 280–81, fig. 94, Pl. XII, fig. 1; 1953: 168–70, fig. 119b; 1956: 32; Kenny, 1970: 85; Thompson, 1973: 247, figs. 2c, 3g.
Elysia marginata Allan, 1947: 439, Pl. XLI, fig. 7; Kenny, 1960: 223; Marcus, 1965: 270; Burn, 1972: 177; var. *minor* Baba, 1957: 72, Pl. III, fig. 5, Pl. IV, figs. 6a, 6b.
Elysia nigropunctata Bergh, 1873: 80–82, Pl. IX, fig. 7, Pl. XI, figs. 7–12; Eliot, 1899: 521; ? Risbec, 1928: 284–286, fig. 96, Pl. XII, fig. 9; var. *sanguinea* Hedley, 1899: 486, fig. 49.

DESCRIPTION: The Guam specimens examined vary from 19.1 to 28.6 mm in length. The animal is not heavy bodied and the parapodia are held upright and partly open when the animal is crawling (Fig. 14). The surface and edge of the parapodia and the rest of the body are smooth. The pericardium (Fig. 5a) is elongate with four main veins on each side: one posterolateral and the other three lateral. The veining is fairly large but is transparent and difficult to see.

COLOR ALIVE: The color of the various specimens collected on Guam appears to include Pease's descriptions of *E. ornata, marginata* and *nigropunctata*. The basic body color varies from a creamish tan, or light olive green to darker shades within the same color ranges. The parapodial margin is edged in black with a submarginal band that may vary from a light yellow to a dark orange. In some specimens this band is intermittent. A fine white line can occasionally be found just below the black margin. The rhinophores are usually tipped in black which appears to be

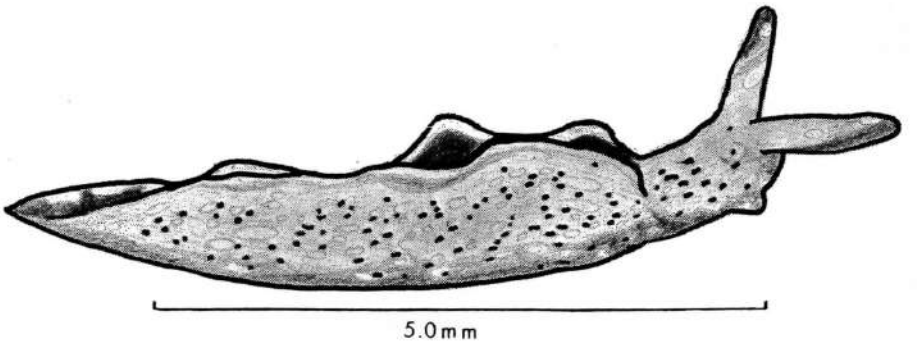

Fig. 14. *Elysia marginata*, 6.4 mm.

overlying an orange base. Sometimes the black pigmentation is not very dense giving the impression of a dark orange-brown tip. The rhinophores are also edged in black along the auriculate edges. The whole animal is covered with black spots intersperced with white dots of varying sizes with those on the foot being finer than those elsewhere. The pericardium is slightly lighter than the general body color and is spotted.

COLOR PRESERVED: The preserved animal is translucent tan with black pigmentation remaining as in the live animal. The venous network visible in the live animal was not visible in the preserved specimens.

RADULA: In a 28.6 mm specimen there were four teeth in the ascending series, six in the descending and about ten loose teeth in the ascus. The tooth in use (Fig. 10e) was 140 μm long. The teeth are long, narrow, with base accounting for about one-third of the length of the tooth. All of the teeth have a smooth cutting edge.

HABITAT: Specimens of *Elysia marginata* have been found on Guam at Bile Bay, Double Reef and Gun Beach on the leeward side and at Pago Bay on the windward side of the island.

Elysia marginata was described from Hawaii (Pease, 1860) and reported from the Society Islands (Pease, 1871), Indonesia (Bergh, 1905), New Caledonia (Risbec, 1928), Ellice Islands (Hedley, 1899), Samoa (Eliot, 1899), Palau Islands (Marcus, 1965), Marshall Islands (Marcus, 1965), Australia (Allan, 1947; Kenny, 1960, 1970; Burn, 1972; Thompson, 1973) and Viet Nam (Risbec, 1956). This species was also observed by the authors in Truk in the Eastern Carolines and Saipan in the Mariana Islands.

REMARKS: Allan (1947) suggested that *E. marginata* be united with *E. grandifolia* Kelaart (1858). Baba (1966) and Eveline Marcus (1972) combined *E. grandifolia*, *E. ornata* (Pease) and *E. marginata* (Pease) with *E. ornata* (Swainson). At the present time, we believe that *E. grandifolia* and *E. marginata* are distinct on the basis of radula, size and shape of parapodia, veining within the parapodia, basic coloration, habitat, and possibly the retention or nonretention of black pigmentation in alcohol. *Elysia ornata* (Swainson) and *E. grandifolia* share the minutely serrate radula and

high parapodia. There appear to be some differences in the veining inside the parapodia and the shape of the base of the teeth. Should further study equate these two, then Swainson's *E. ornata* has priority.

Eliot (1906) and Macnae (1954) synonomize *E. punctata* Kelaart and *E. nigropunctata* (Pease). In Kelaart's description of *E. punctata* he mentions that the under surface of the "wings" (Parapodia) were tubercular [a fact pointed out to us by R. Burn (pers. comm.)]. Macnae does not mention this when describing his *E. punctata* var. *rubropunctata*. It is also difficult to compare Macnae's drawing of the radula with Bergh's drawing of the teeth of *E. nigropunctata* or the radula drawings we have made of the Guam specimens. *Elysia punctata* has priority over *E. marginata* if it is shown later that these two species are the same.

Elysia mercieri (Pruvot-Fol, 1930)
Figs. 15, 16a

Elysiobranchus mercieri Pruvot-Fol, 1930: 230
Elysia mercieri Pruvot-Fol, 1946: 40

DESCRIPTION: Animals (Fig. 15a) are very distinctive having two pairs of very long branched processes (Fig. 15b) extending upward from the edge of the parapodia. The animals are very small, varying in length from 2.4 to 6.5 mm. The parapodia are sometimes held together and sometimes held open only between the pairs of projections. The body surface is covered with smaller unbranched projections. The rhinophores are very long and thin, becoming almost pointed at the tip. The pericardium is very small. When crawling the animal moves with a jerking motion. The eye spots are rounded, black, and protrude.

COLOR ALIVE: The Guam specimens appear green, spotted with dark green.

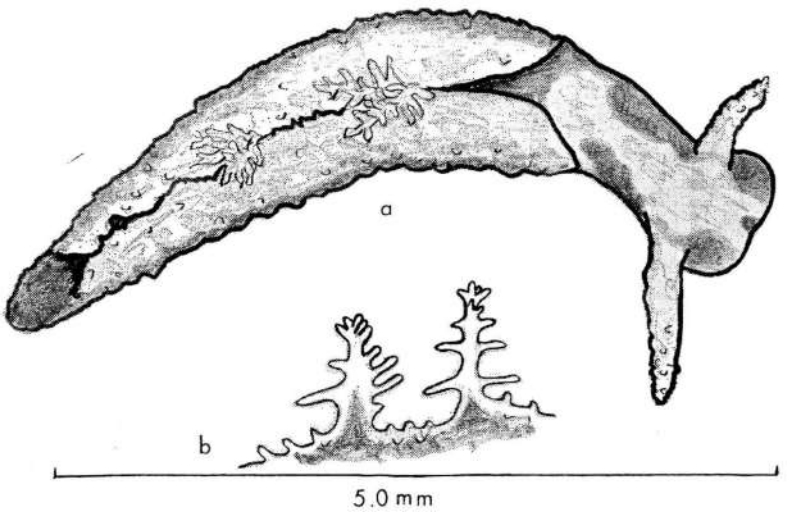

Fig. 15. *Elysia mercieri*: a, dorsal view of a 6.4 mm animal; b, detail of projections.

Through the microscope small dots of white cover the green more densely on the foot than on the parapodia. The upper part of the parapodia is a mottled tan with some pink opaque dots along the edge where green and tan meet. The projections are basically transparent with some mottled tan.

COLOR PRESERVED: The preserved animals are a uniform light tan with some brown flecks around the mouth.

RADULA: On a 6.0 mm specimen the radula had five teeth in the ascending series and six in the descending. We were unable to ascertain the state of the ascus. The teeth are very small with a short heavy base and minute serrations along the cutting edge. The tooth in use (Fig. 16a) was 71 μm.

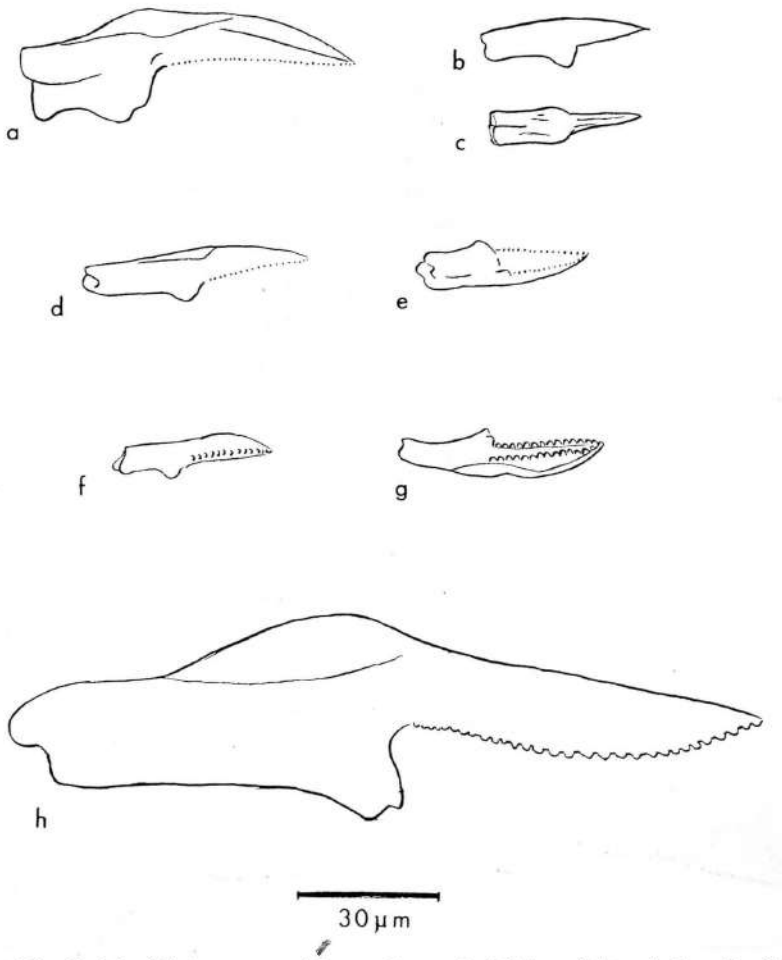

Fig. 16. Radula (all to same scale): a, *E. mercieri* (6.0 mm) lateral view; b, *E. obtusa* (10.3 mm) lateral view; c, *E. obtusa* (10 3.mm) ventral view; d, *E. ratna* (23.5 mm) lateral view; e, *E. ratna* (23.5 m) ventral view; f, *E. vatae* (9.5 mm) lateral view; g, *E. vatae* (9.5 mm) ventral view; h, *E. yaeyamana* (25.4 mm) lateral view.

HABITAT: Guam specimens of *Elysia mercieri* have been found throughout the year but most frequently in June and November. It is most common on the reef flat but has been found to a depth of 2.4 m. The animals are very difficult to see because of their small size, coloration and motion which make them look like a small piece of algae moving with the wave action. Many of those found have been on the authors' gloves after handling algae covered coral rubble. No definite algal association has been established for *E. mercieri.*

SPECIMENS: Fifty-nine specimens have been found on Guam at Bile Bay, Apra Harbor, Cetti Bay and Double Reef on the leeward side and at Pago Bay on the windward side of the island.

Elysia mercieri was described from New Caledonia (Pruvot-Fol, 1930).

REMARKS: Pruvot-Fol (1930) established *Elysiobranchus* as a new genus with the following description: "forme d'*Elysia.* Expansions aliformes relevées et portant sur leurs bords dressés, ramifiés, au nombre de quatre paires (dont la plus antérieure est très petite)." Of *E. mercieri* the only description given by Pruvot-Fol is "Caracteres du genre. Coleur verte tachetée de vert plus foncé, appendices incolores." In 1946 Pruvot-Fol changed Elysiobranchus to a subgenus rather than a genus and added only the information that *E. mercieri* has the teeth of an *Elysia* and is a small animal.

Although the Guam animals have only two pairs of projections whereas Pruvot-Fol's animals have four pairs, we believe them to be the same since *Elysia mercieri* is the only *Elysia* described with long branched processes. The projections are obvious even on the preserved specimens.

Elysia obtusa Baba, 1938
Figs. 16b–c, 17

Baba, 1938: 8, fig. 6; 1949: 35, 131–32, fig. 26, Pl. IX, figs. 28, 29; Abe, 1964: 31, Pl. XII, fig. 42.

DESCRIPTION: Animals (Fig. 17) are moderately thin when crawling. Specimens vary from 3.7 to 10.3 mm in length. The parapodia are held over the dorsum

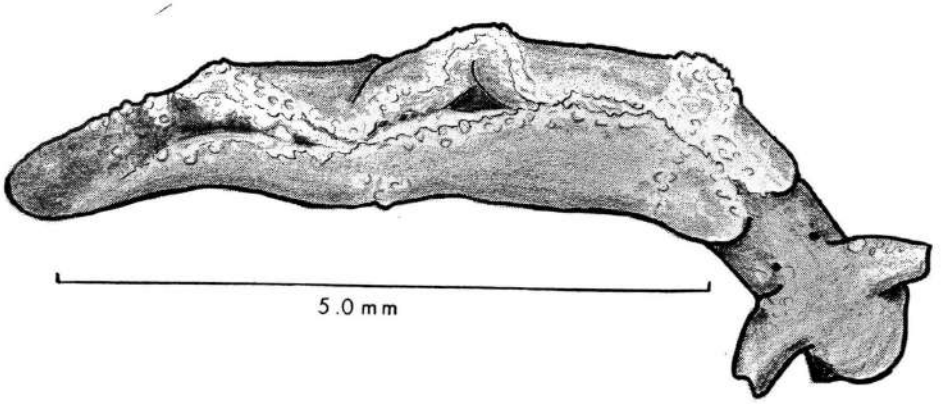

Fig. 17. *Elysia obtusa,* 7.9 mm.

but not together. The short rhinophores are held almost parallel with the substrate and tend to point more laterally than anteriorly. The animal is basically smooth with some small sparce conical projections occurring over the parapodia, head and rhinophores. The rounded, slightly elongate pericardium has two single large veins extending along the lower part of each parapodia.

COLOR ALIVE: The color of the Guam specimens matches Baba's (1938) description and the color plates in Baba (1949). The general body color is a translucent pale green or greenish yellow with a darker green internal pigmentation. This internal pigmentation may be almost totally lacking or to the other extreme, be throughout the whole animal. The conical projections are white as is the edge of the parapodia. The white on the edge of the parapodia tends to be more developed in the inner than the outer edge.

COLOR PRESERVED: The preserved animal has a wrinkled texture and is a uniform light tan which is slightly lighter on the edges of the parapodia.

RADULA: In a 10.3 mm specimen there were ten teeth in the ascending series and seven in the descending. The teeth are finely serrate on the cutting edge. The base of the tooth is broad in comparison to the cutting edge and about equal in length to the cusp. The tooth in use (Fig. 16b, 16c) of the above specimen was 38 μm in length.

HABITAT: Specimens of *Elysia obtusa* have been found on Guam from the reef flat to a depth of 2.4 m but are most frequent on the reef flat.

No definite algal association has been established for *Elysia obtusa.*

SPECIMENS: Twelve specimens have been found on Guam at Bile Bay, Cocos Lagoon and Cocos reef on the leeward side and at Pago Bay on the windward side of the island.

Elysia obtusa was described from Japan (Baba, 1938) and further reported from Japan (Baba, 1949; Abe, 1964).

REMARKS: The identification as *Elysia obtusa* was made on the basis of the color description, color plates and radula as described by Baba.

Elysia ratna Marcus, 1965

Figs. 5e, 16d–e, 18

Marcus, 1965: 270, figs. 7, 8.

DESCRIPTION: Animals (Fig. 18) are long and thin when crawling. Specimens have varied from 10.0 to 24.5 mm in length. The parapodia are not high and meet in an even line down the middorsum. The body surface is smooth. The pericardium is short and rounded. There is a single posterior vein (Fig. 5e) that branches into four main parts after leaving the pericardium. In the drawing by Marcus (1965), four veins are shown as coming from the posterior of the pericardium.

COLOR ALIVE: The living animal appears to the naked eye to be a dark green with longitudinal black stripes. Through the microscope it can be seen that it matches the description of Marcus in that the base color is dark brown or black with fine longitudinal yellow lines. The lines may broaden at regular intervals

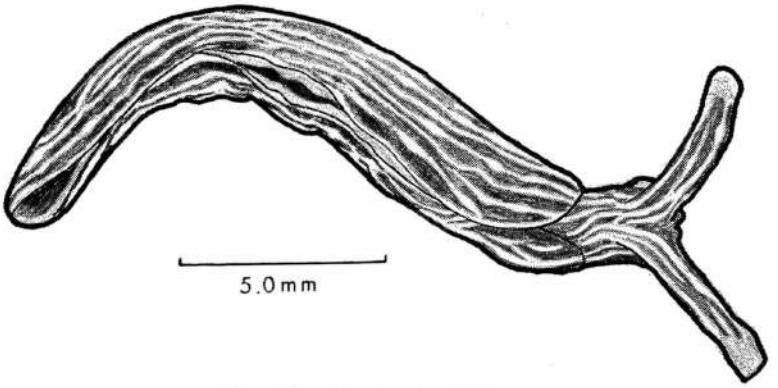

Fig. 18. *Elysia ratna*, 19.1 mm.

giving the body a banded appearance. These lines occur on the head and rhinophores as well as the exterior of the parapodia. The tips of the rhinophores, anterior of the foot and inner margin of the parapodia are burnt orange.

COLOR PRESERVED: The preserved animal is a very light tan with some broken vertical bands of brown on the sides of the parapodia and brown stripes on the rhinophores. The foot is grey with some lighter grey lines. The inside of the parapodia is grey becoming slightly darker toward the margin which is light tan.

RADULA: The teeth are denticulate on both sides and have a cusp that is slightly longer than the base. On a 23.5 mm specimen there were eight ascending and nine descending teeth. The tooth in use (Fig. 16d, 16e) was 53 μm long.

HABITAT: Specimens of *Elysia ratna* have been found on Guam from the reef flat to a depth of 5.5 m but are most commonly found between the reef flat and 2.4 m.

No definite algal association has been established for *Elysia ratna*.

SPECIMENS: Fifty two specimens have been found on Guam at Agat, Apra Harbor, Bile Bay, Cetti Bay, Cocos reef, Cody Beach and Sella Bay, all on the leeward side of the island.

Elysia ratna was described from Palau (Marcus, 1965) and has also been observed by the authors in Ponape in the Eastern Caroline Islands and in Palau.

REMARKS: As with *Elysia bayeri*, the original description does not mention denticulations on both edges of the teeth. There is, however, little question that the Guam animals are the same as those described by Marcus. From a side view the teeth of the Guam *E. ratna* match the original drawings. The description of the animal and color alive are the same as described by Marcus (1965).

Elysia vatae Risbec, 1928

Figs. 5c, 16f–g, 19

Risbec, 1928: 281, Pl. XII, fig. 7; 1953: 170, fig. 122; Bergh, 1905: Pl. 5, fig. 17 [as *Elysia* sp.].

DESCRIPTION: Animals (Fig. 19) are smooth bodied. Specimens examined have varied from 3.2 to 11.1 mm in length. The parapodia are not high and mornally

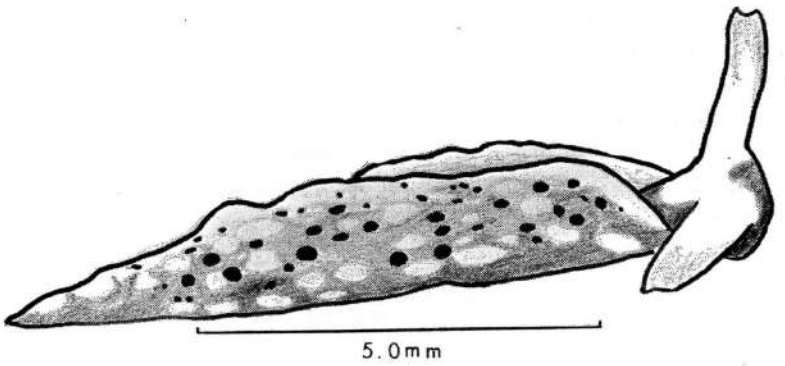

Fig. 19. *Elysia vatae*, 9.5 mm.

meet in an even line over the middorsum and extend posteriorly to the end of the tail. The rhinophores are generally held somewhat forward and lateral. The pericardium (Fig. 5c) is small and rounded with three large veins; one pair from each side and one vein extending posteriorly. The veins branch into the parapodia and are also visible on the preserved animals. The anus is anterolateral.

COLOR ALIVE: The color of the Guam specimens is basically the same as that given by Risbec (1928). The Guam animals are grey with mottled black spots and yellow blotches. The edge of the parapodia is a light yellow, white in some specimens. The rhinophores are white tipped in orange. The foot is grey.

COLOR PRESERVED: The preserved animals have medium grey to light tan bodies with black spots over the exterior of the parapodia. The rhinophores and edges of the parapodia are light grey. The tips of the rhinophores have a brownish tinge. A black or dark grey line extends down the middle of the head.

RADULA: The radula on a 9.5 mm specimen was very small with ten teeth in the ascending series and eight in the descending plus four juvenile teeth extending straight in the row. There were no loose teeth. The tooth in use (Fig. 16f, 16g) was 34 μm long, the base 15 μm and the cusp 19 μm. The teeth on the Guam animals are coarsely denticulate on each side.

HABITAT: Specimens of *Elysia vatae* have been found on Guam from the reef flat to a depth of 4 m, but are most common from the reef flat to 2.4 m. They have been found on Guam throughout the year but are most frequent in August.

No definite algal association has been established for this species.

SPECIMENS: Eighteen specimens have been found on Guam at Agat, Bile Bay, Cocos reef, Double Reef and Gun Beach, all on the leeward side of the island.

Elysia vatae was described from New Caledonia (Risbec, 1928) and has also been observed by the authors at Maug in the Northern Mariana Islands and in Palau.

REMARKS: The Guam animal varies slightly from the original description given by Risbec (1928). Whereas the Guam animal is grey mottled with black and yellow, Risbec's specimen is described as purple mottled with violet and yellow. The color patterning and the color of rhinophores are the same. Risbec described the

teeth as finely denticulate without prominent cusps but the basic radular formation is the same as the Guam animals with the juvenile teeth still attached in the row.

Pruvot-Fol (1946) had provisionally placed *E. vatae* in the genus *Thuridilla* based on the teeth shaped like the *Placobranchus* and on both shape and coloration; but also said too little information was available to make the determination. If Bergh's criteria is used, *E. vatae* cannot be a *Thuridilla* because of the anterior position of the anus.

Elysia yaeyamana Baba, 1936
Figs. 16h, 20

Baba, 1936: 21, fig. 10, Pl. 2, fig. 2.

DESCRIPTION: Animals (Fig. 20) are very long, somewhat broad with moderately high parapodia which meet irregularly on the midline. The Guam specimens have been from 25.4 to 27.0 mm in length. The parapodia extend to the end of the tail. The rhinophores are short, blunt and held erect. The pericardium in the preserved animals is long, narrow and constricted in the middle. No veining was visible.

COLOR ALIVE: The Guam animals match the description given by Baba (1936), being a rich velvety green or brownish green. The internal and external surfaces of the parapodia have white spots. The edges of the parapodia are lined with orange. There is a submarginal black line below the orange. The rhinophores are tipped in yellow green as are the anterior edge of the foot and the upper part of the mouth.

COLOR PRESERVED: Preserved, the specimens are a uniform tan.

RADULA: The radula of a 25.4 mm specimen had four teeth in the ascending series and six in the descending. There were numerous loose teeth in the ascus. The shape and size of the teeth are identical to Baba's, having a long base, a pointed blade and serrations on the cutting edge. The tooth in use (Fig. 16h) was 162 μm long.

HABITAT: Guam specimens of *Elysia yaeyamana* have been found in April and in June on the reef flat. No algal association has been established.

SPECIMENS: Only three specimens have been found on Guam at Bile Bay and Facpi Point on the leeward side of the island.

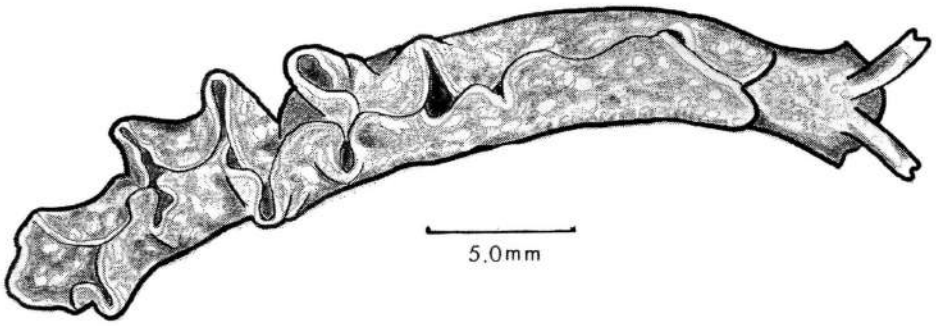

Fig. 20. *Elysia yaeyamana*, 9.5 mm.

Elysia yaeyamana was described from Okinawa (Baba, 1936).

REMARKS: The only variation between the Guam animals and Baba's (1936) description is that Baba does not mention a submarginal black line on the parapodia.

The teeth of *Elysia yaeyamana* are very similar to those of *E. bennettae* except that the blade on *E. yaeyamana* is narrower.

Discussion

Five species of Elysia are commonly found on Guam: *Elysia bayeri, E. livida, E. halimedae, E. mercieri,* and *E. ratna. Elysia grandifolia* is readily available when windward waves are calm enough to examine *Bryopsis pennata* on the reef flat.

Although there has been disagreement in the past on the validity of using radula as a species distinctive feature in Elysia, the variation found in the Guam animals, both those identified and those not identified, lead us to believe that the radula in adult animals is a good species specific characteristic. Camera lucida drawings (Figs. 6, 10, 16) reveal that teeth which, upon first examination, seem the same are in fact different.

A feature which needs further examination is the shape and size of the pericardium and patterning of the veins within the parapodia—a feature also noted by Marcus and Marcus (1970). The veining in the Guam animals (Fig. 5) would indicate the possibility that in some cases this could also be a distinctive trait. One disadvantage is using the veining is that it may disappear in the preserved specimens and therefore needs to be recorded from living specimens.

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